

# MICROBIOLOGICAL REVIEWS

VOLUME 57 • MARCH 1993 • NUMBER 1

**Wolfgang K. Joklik**, *Editor in Chief* (1995)

*Duke University Medical Center  
Durham, N.C.*

**John C. Boothroyd**, *Editor* (1997)  
*Stanford University School of  
Medicine  
Stanford, Calif.*

**Jean E. Brenchley**, *Editor* (1997)  
*The Pennsylvania State University  
University Park, Pa.*

**Franklin M. Harold**, *Editor* (1997)  
*Colorado State University  
Fort Collins, Colo.*

**Alan G. Hinnebusch**, *Editor* (1997)  
*National Institute of Child Health  
and Human Development  
Bethesda, Md.*

**Jack D. Keene**, *Editor* (1997)  
*Duke University Medical Center  
Durham, N.C.*

**Stephen Lory**, *Editor* (1997)  
*University of Washington  
Seattle, Wash.*

**Catherine L. Squires**, *Editor*  
(1997)

*Columbia University  
New York, N.Y.*

**James T. Staley**, *Editor* (1997)  
*University of Washington  
Seattle, Wash.*

**James M. Tiedje**, *Editor* (1997)  
*Michigan State University  
East Lansing, Mich.*

**O. C. Yoder**, *Editor* (1997)  
*Cornell University  
Ithaca, N.Y.*

---

**Barbara H. Iglewski**, *Chairman, Publications Board*

**Jack Kenney**, *Production Editor*

**Linda M. Illig**, *Director, Journals*

**Julie A. Antolick**, *Assistant Production Editor*

---

*Microbiological Reviews* considers for publication both solicited and unsolicited reviews and monographs dealing with all aspects of microbiology. Manuscripts, proposals, and correspondence regarding editorial matters should be addressed to the Editor in Chief, Wolfgang K. Joklik, Department of Microbiology and Immunology, P.O. Box 3020, Duke University Medical Center, Durham, NC 27710.

---

*Microbiological Reviews* is published quarterly (March, June, September, and December), one volume per year, by the American Society for Microbiology (ASM). The nonmember print subscription prices are \$120 (U.S.) (Canadians add 7% GST) and \$136 (other countries) per year; single copies are \$40 (Canadians add 7% GST). The member print subscription prices are \$25 (U.S.) (Canadians add 7% GST) and \$39 (other countries); single copies are \$10 (Canadians add 7% GST). For prices of CD-ROM versions, contact the Subscriptions Unit, ASM. Correspondence relating to subscriptions, defective copies, missing issues, and availability of back issues should be directed to the Subscriptions Unit, ASM; correspondence relating to reprint orders should be directed to the Reprint Order Unit, ASM; and correspondence relating to disposition of submitted manuscripts, proofs, and general editorial matters should be directed to the Journals Division, American Society for Microbiology, 1325 Massachusetts Ave., N.W., Washington, DC 20005-4171. Phone: (202) 737-3600.

Claims for missing issues from residents of the United States, Canada, and Mexico must be submitted within 3 months after publication of the issues; residents of all other countries must submit claims within 6 months of publication of the issues. Claims for issues missing because of failure to report an address change or for issues "missing from files" will not be allowed.

日本：価格は外貨表示とは関係なく円建。

Second-class postage paid at Washington, DC 20005, and at additional mailing offices.

POSTMASTER: Send address changes to *Microbiological Reviews*, ASM, 1325 Massachusetts Ave., N.W., Washington, DC 20005-4171.

Made in the United States of America. Printed on acid-free paper.

Copyright © 1993, American Society for Microbiology.

All Rights Reserved.

ISSN: 0146-0749

CODEN: MBREDS

---

The code at the top of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal use or for personal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per-copy fee through the Copyright Clearance Center, Inc., 27 Congress St., Salem, MA 01970, for copying beyond that permitted by Sections 107 and 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.

# MICROBIOLOGICAL REVIEWS

## INSTRUCTIONS TO AUTHORS

### Scope

*Microbiological Reviews* publishes reviews dealing with all aspects of microbiology and other fields of concern to microbiologists, such as immunology. Authoritative and critical reviews of the current state of knowledge are preferred, although historical analyses will be accepted if the importance of the subject justifies this approach. *Unevaluated compilations of the literature and annotated bibliographies do not fall within the scope of Microbiological Reviews*. Manuscripts of lectures delivered at symposia and round tables are likewise unacceptable; however, their authors are encouraged to discuss with the editor the possibility of using such material as the basis for preparation of a review when publication in this form seems appropriate. Because a distinctive goal of the journal is to appeal to the interests of its diverse group of subscribers, authors are asked to address themselves to both specialists and generalists; this demands conscious concern for this goal in writing.

Manuscripts reach *Microbiological Reviews* by one of three mechanisms. First, reviews are solicited by the editors from leading investigators around the world. Second, unsolicited reviews are submitted in completed form. Such manuscripts should be accompanied by a curriculum vitae and bibliography for each author, together with the names, addresses, and telephone/fax numbers of at least six experts in the field, two of whom may be asked to review the manuscript with respect to its suitability for publication in *Microbiological Reviews*. Third, suggestions for reviews of subjects that have not been reviewed recently are submitted to the editors. Such suggestions should be accompanied by an annotated topical outline; a one- or two-paragraph statement describing the aim, scope, and relevance of the review; a list of key references showing the author's contributions to the field, as well as other investigators' findings; and a curriculum vitae and bibliography for each proposed author. Such outlines will be evaluated by the editors, and if the material is satisfactory, the authors will be invited to write the review.

### How To Submit Manuscripts

Send manuscripts or outlines directly to Dr. W. K. Joklik, Department of Microbiology and Immunology, P.O. Box 3020, Duke University Medical Center, Durham, NC 27710.

Submit **four** complete copies of each manuscript, including figures and tables, either in the original typescript or as clear, clean photocopies. Include four copies of the summary (250 words maximum), which will be included in the issue table of contents. The name, mailing address, and telephone and fax numbers of the corresponding author should be indicated on the

title page. All text should be **double or triple spaced**, including quotations, tables, figure legends, and references, and the pages must be numbered sequentially.

It is recommended that the following sets of characters be easily distinguishable in the manuscript: the numeral zero (0) and the letter "oh" (O); the numeral one (1), the letter "el" (l), and the letter "eye" (I); and a multiplication sign (×) and the letter "ex" (x). If such distinctions cannot be made, please mark these items at first occurrence for cell lines, strain and genetic designations, viruses, etc., on the modified manuscript so that they may be identified properly for the printer by the copy editor.

Original drawings or glossy prints are required. When appropriate, magnification should be indicated by a suitable scale on the photograph. Each figure should be numbered and should include the name of the author, either in the margin or on the back (marked lightly with a *soft* pencil). To avoid damage in transit, do not submit illustrations larger than 8½ by 11 inches.

Papers should seldom exceed 100 manuscript text pages; any excess will require discussion with the editor.

A review, whether invited or not, cannot be finally accepted until the finished product has been examined and found to be satisfactory.

It is expected that the author will include written assurance that permission to cite personal communications and preprints has been granted.

### EDITORIAL POLICY

By submission of a manuscript to the journal, the authors guarantee that the manuscript, or one substantially the same, was not published previously, is not being considered or published elsewhere, and will not be published elsewhere. All authors of a manuscript must have agreed to its submission and are responsible for its content, including appropriate citations and acknowledgments, and must also have agreed that the corresponding author has the authority to act on their behalf on all matters pertaining to publication of the manuscript.

Failure to comply with the above-mentioned policy may result in a suspension of publishing privileges in ASM journals for up to 5 years.

### Primary Publication

The American Society for Microbiology accepts the definition of primary publication as defined in *How to Write and Publish a Scientific Paper*, third edition, by Robert A. Day, to wit: ". . . (i) the first publication of original research results, (ii) in a form whereby peers of the author can repeat the experiments and test the conclusions, and (iii) in a journal *or other source*

*document* [emphasis added] readily available within the scientific community.”

A scientific paper published in a conference report, symposium proceeding, technical bulletin, or any other retrievable source is unacceptable for submission to an ASM journal on grounds of *prior publication*. A preliminary disclosure of research findings published in abstract form as an adjunct to a meeting, e.g., part of a program, is not considered “prior publication” because it does not meet the criteria for a scientific paper.

It is incumbent upon the author to acknowledge any prior publication of the data contained in a manuscript submitted to an ASM journal even though he or she may not consider such publication in violation of ASM policy. A copy of the relevant work should accompany the paper.

### Permissions

The corresponding author is responsible for obtaining permissions from both the original publisher and the original author [i.e., the copyright owner(s)] to reproduce figures, tables, or text (in whole or in part) from previous publications. The signed permissions must be submitted to ASM, and each should be identified as to the relevant item in the MR manuscript (e.g., “permissions for MR Fig. 1”).

### Copyright

To maintain and protect the Society’s ownership and rights and to protect the original authors from misappropriations of their work, ASM requires the corresponding author to sign a copyright transfer agreement on behalf of all the authors. This agreement is sent to the corresponding author when the manuscript is accepted and scheduled for publication. Unless this agreement is executed (without changes and/or addenda), ASM will not publish the manuscript.

If *all* authors were employed by the U.S. government when the work was performed, the corresponding author should not sign the copyright transfer agreement but should, instead, attach to the agreement a statement attesting that the manuscript was prepared as a part of their official duties and, as such, is a work of the U.S. government not subject to copyright.

If *some* of the authors were employed by the U.S. government when the work was performed but the others were not, the corresponding author should sign the copyright transfer agreement as it applies to that portion performed by the non-government employee authors.

### Authorship

An author is one who made a substantial contribution to the article; therefore, ASM considers all authors responsible for the entire paper. Individuals who provided assistance, e.g., supplied strains or critiqued the paper, need not be listed as authors but should be recognized in the Acknowledgment section.

All authors must agree to the order in which their names are listed in the byline. Footnotes regarding attribution of work (e.g., X. Jones and Y. Smith contributed equally to. . .) are not permitted. If necessary, such statements may be included in the Acknowledgment section.

### Editorial Style

The editorial style of *Microbiological Reviews* conforms to the *CBE Style Manual* (5th ed., 1983; Council of Biology Editors, Inc., 9650 Rockville Pike, Bethesda, Md.), *ASM Style Manual for Journals and Books* (American Society for Microbiology, 1991), and Robert A. Day’s *How to Write and Publish a Scientific Paper* (3rd ed., 1988; Oryx Press), as interpreted and modified by the editorial board and the ASM Journals Division. All reviews, whether invited or not, *must* conform to the stylistic conventions set forth in the Instructions to Authors. Any deviations from this style must be approved by the Journals Division.

Include a table of contents showing the major headings and subheadings of the text. Consult a recent issue of *Microbiological Reviews* for format and style.

Summarize supporting evidence whenever possible. When original data are presented, it is essential that the methods be fully described or that reference be made to previously published methods.

### References

All listed references **must** be cited in the text. Arrange the references in **alphabetical** order, by first author, and number consecutively. Abbreviate journal names according to *Serial Sources for the BIOSIS Data Base* (BioSciences Information Service, 1992). Cite each listed reference in the text by number.

Follow the styles shown in the examples below.

1. Anagnostopoulos, C., and J. Spizizen. 1961. Requirements for transformation in *Bacillus subtilis*. *J. Bacteriol.* 81:741–746.
2. Berry, L. J., R. N. Moore, K. J. Goodrum, and R. E. Couch, Jr. 1977. Cellular requirements for enzyme inhibition by endotoxin in mice, p. 321–325. In D. Schlesinger (ed.), *Microbiology—1977*. American Society for Microbiology, Washington, D.C.
3. Cox, C. S., B. R. Brown, and J. C. Smith. *J. Gen. Genet.*, in press.\*
4. Dhople, A., I. Ortega, and C. Berauer. 1989. Effect of oxygen on in vitro growth of *Mycobacterium leprae*, abstr. U-82, p. 168. Abstr. 89th Annu. Meet. Am. Soc. Microbiol. 1989.
5. Finegold, S. M., W. E. Shepherd, and E. H. Spaulding. 1977. Cumitech 5, Practical anaerobic bacteriology. Coordinating ed., W. E. Shepherd. American Society for Microbiology, Washington, D.C.
6. Fitzgerald, G., and D. Shaw. In A. E. Waters (ed.), *Clinical microbiology*, in press. EFH Publishing Co., Boston.
7. Gustlethwaite, F. P. 1985. Letter. *Lancet* ii:327.
8. Jacoby, J., R. Grimm, J. Bostic, V. Dean, and G. Starke. Submitted for publication.

9. Jensen, C., and D. S. Schumacher. Unpublished data.
10. Jones, A. (Yale University). 1990. Personal communication.
11. Leadbetter, E. R. 1974. Order II. *Cytophagales* nomen novum, p. 99. In R. E. Buchanan and N. E. Gibbons (ed.), *Bergey's manual of determinative bacteriology*, 8th ed. The Williams & Wilkins Co., Baltimore.
12. Miller, J. H. 1972. *Experiments in molecular genetics*, p. 352–355. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y.
13. Powers, R. D., W. M. Dotson, Jr., and F. G. Hayden. 1982. Program Abstr. 22nd Intersci. Conf. Antimicrob. Agents Chemother., abstr. 448.
14. Sigma Chemical Co. 1989. Sigma manual. Sigma Chemical Co., St. Louis, Mo.
15. Smith, J. C. April 1970. U.S. patent 484,363,770.
16. Smyth, D. R. 1972. Ph.D. thesis. University of California, Los Angeles.
17. Yagupsky, P., and M. A. Menegus. 1989. Intraluminal colonization as a source of catheter-related infection. *Antimicrob. Agents Chemother.* 33:2025. (Letter.)

\* Note that an “in press” reference to an ASM publication should state the control number (e.g., AEM 576-93) or the name of the publication if it is a book.

## Abbreviations

**General.** Abbreviations should be used as an aid to the reader, rather than as a convenience to the author, and therefore their use should be limited. Abbreviations other than those recommended by the IUPAC-IUB (*Biochemical Nomenclature and Related Documents*, 1978) should be used only when a case can be made for necessity, such as in tables and figures.

It is often possible to use pronouns or to paraphrase a long word after its first use (e.g., “the drug,” “the substrate”). Standard chemical symbols and trivial names or their symbols (folate, Ala, Leu, etc.) may be used for terms that appear in full in the neighboring text.

Define each abbreviation and introduce it in parentheses the first time it is used: e.g., “cultures were grown in Eagle minimal essential medium (MEM).” Generally, eliminate abbreviations that are not used at least five times in the text (including tables and figure legends).

**Not requiring introduction.** In addition to abbreviations for Système International d’Unités (SI) units of measurement, other common units (e.g., bp, kb, and Da), and chemical symbols for the elements, the following should be used without definition in the title, abstract, text, figure legends, and tables: DNA (deoxyribonucleic acid); cDNA (complementary DNA); RNA (ribonucleic acid); cRNA (complementary RNA); RNase (ribonuclease); DNase (deoxyribonuclease); rRNA (ribosomal RNA); mRNA (messenger RNA); tRNA (transfer RNA); AMP, ADP, ATP, dAMP, ddATP, GTP, etc. (for the respective 5' phosphates of adenosine and other nucleosides) (add 2',

3', or 5' when needed for contrast); ATPase, dGTPase, etc. (adenosine triphosphatase, deoxyguanosine triphosphatase, etc.); NAD (nicotinamide adenine dinucleotide); NAD<sup>+</sup> (nicotinamide adenine dinucleotide, oxidized); NADH (nicotinamide adenine dinucleotide, reduced); NADP (nicotinamide adenine dinucleotide phosphate); NADPH (nicotinamide adenine dinucleotide phosphate, reduced); NADP<sup>+</sup> (nicotinamide adenine dinucleotide phosphate, oxidized); poly(A), poly(dT), etc. (polyadenylic acid, polydeoxythymidylic acid, etc.); oligo(dT), etc. (oligodeoxythymidylic acid, etc.); P<sub>i</sub> (orthophosphate); PP<sub>i</sub> (pyrophosphate); UV (ultraviolet); PFU (plaque-forming units); CFU (colony-forming units); MIC (minimal inhibitory concentration); MBC (minimal bactericidal concentration); Tris [tris(hydroxymethyl)aminomethane]; DEAE (diethylaminoethyl); A<sub>260</sub> (absorbance at 260 nm); EDTA (ethylenediaminetetraacetic acid); and AIDS (acquired immunodeficiency [or immune deficiency] syndrome). Abbreviations for cell lines (e.g., HeLa) also need not be defined.

The following abbreviations should be used without definition in tables:

amt (amount)	SE (standard error)
approx (approximately)	SEM (standard error of the mean)
avg (average)	
concn (concentration)	sp act (specific activity)
diam (diameter)	sp gr (specific gravity)
exptl (experimental)	temp (temperature)
expt (experiment)	tr (trace)
ht (height)	vol (volume)
mo (month)	vs (versus)
mol wt (molecular weight)	wk (week)
no. (number)	wt (weight)
prepn (preparation)	yr (year)
SD (standard deviation)	

## Reporting Numerical Data

Standard metric units are used for reporting length, weight, and volume. For these units and for molarity, use the prefixes m,  $\mu$ , n, and p for 10<sup>-3</sup>, 10<sup>-6</sup>, 10<sup>-9</sup>, and 10<sup>-12</sup>, respectively. Likewise, use the prefix k for 10<sup>3</sup>. Avoid compound prefixes such as m $\mu$  or  $\mu\mu$ . Use  $\mu\text{g/ml}$  or  $\mu\text{g/g}$  in place of the ambiguous ppm. Units of temperature are presented as follows: 37°C or 324 K.

When fractions are used to express units such as enzymatic activities, it is preferable to use whole units, such as “g” or “min,” in the denominator instead of fractional or multiple units, such as  $\mu\text{g}$  or 10 min. For example, “pmol/min” would be preferable to “nmol/10 min,” and “ $\mu\text{mol/g}$ ” would be preferable to “nmol/ $\mu\text{g}$ .” It is also preferable that an unambiguous form such as exponential notation be used; for example, “ $\mu\text{mol g}^{-1} \text{min}^{-1}$ ” is preferable to “ $\mu\text{mol/g/min}$ .”

See the *CBE Style Manual*, 5th ed., for more detailed information about reporting numbers. Also contained in this source is information on SI units for the reporting of illumination, energy, frequency, pressure, and other physical factors. Always report numerical data in the applicable SI units.

## Nomenclature

The spelling of names should follow the *Approved Lists of Bacterial Names* (amended edition) (V. B. D. Skerman, V. McGowan, and P. H. A. Sneath, ed.) and the *Index of the Bacterial and Yeast Nomenclatural Changes Published in the International Journal of Systematic Bacteriology since the 1980 Approved Lists of Bacterial Names (1 January 1980 to 1 January 1989)* (W. E. C. Moore and L. V. H. Moore, ed.), both published by the American Society for Microbiology in 1989, and the validation lists and articles published in the *International Journal of Systematic Bacteriology* since 1 January 1989. If there is reason to use a name that does not have standing in nomenclature, the name should be enclosed in quotation marks and an appropriate statement concerning the nomenclatural status of the name should be made in the text (for an example, see *Int. J. Syst. Bacteriol.* **30**:547–556, 1980).

Names used for viruses should be those approved by the International Committee on Taxonomy of Viruses (ICTV) and published in the 4th Report of the ICTV, *Classification and Nomenclature of Viruses* (*Intervirology* **17**:23–199, 1982), with the modifications contained in the 5th Report of the ICTV (*Arch. Virol.*, Suppl. 2, 1991). If desired, synonyms may be added parenthetically when the name is first mentioned. Approved generic (or group) and family names may also be used.

For enzymes, use the recommended (trivial) name assigned by the Nomenclature Committee of the International Union of Biochemistry as described in *Enzyme Nomenclature* (Academic Press, Inc., 1992).

Genetic nomenclature should essentially follow the recommendations of Demerec et al. (*Genetics* **54**:61–76, 1966) and those given in the instructions to authors of the *Journal of Bacteriology* and *Molecular and Cellular Biology* (January issues).

## Letters to the Editor

Letters to the Editor must include data to support the writer's argument and are intended only for comments on articles published previously in the journal. They may be **no more than 500 words long**. Send letters to the Journals Division. They will be processed and sent to the editor who handled the article in question. If the editor believes that publication is warranted, he will solicit a reply from the author of the article and

make a recommendation to the editor in chief. Final approval for publication rests with the editor in chief. All letters intended for publication must be typed double spaced.

## Notification of Acceptance

When the editor has decided that the manuscript is acceptable for publication, it is sent to the Journals Division, where it is checked by the production editor. If the manuscript is completely acceptable according to the criteria set forth in these instructions, it is scheduled for the next available issue and an acceptance letter that indicates the month of publication and approximate page proof dates is mailed to the corresponding author.

## Page Proofs

The printer sends page proofs, the copyedited manuscript, and a reprint order form to the corresponding author. As soon as the page proofs are corrected and signed by the person who proofread them (within 48 h), they should be mailed to the ASM Journals Division, 1325 Massachusetts Ave., N.W., Washington, DC 20005-4171.

The proof stage is not the time to make extensive corrections, additions, or deletions. Important new information that has become available between acceptance of the manuscript and receipt of the proofs may be inserted as an Addendum in Proof with the permission of the editor. If references to unpublished data or personal communications are added, it is expected that written assurance granting permission for the citation will be provided. Limit changes to correction of spelling errors, incorrect data, grammatical errors, and updated information for "submitted" and "in press" references.

Questions about late proofs and problems in the proofs should be directed to the ASM Journals Division, telephone (202) 737-3600.

## Reprints

The corresponding author will receive up to 300 free reprints of his contribution; additional reprints (in multiples of 100) may be purchased if desired. An order form that shows the cost of reprints will be sent with the proofs.